

Advanced Safety And Maintenance Technologies For Air Disc Brake Equipped Vehicles

Presented By:

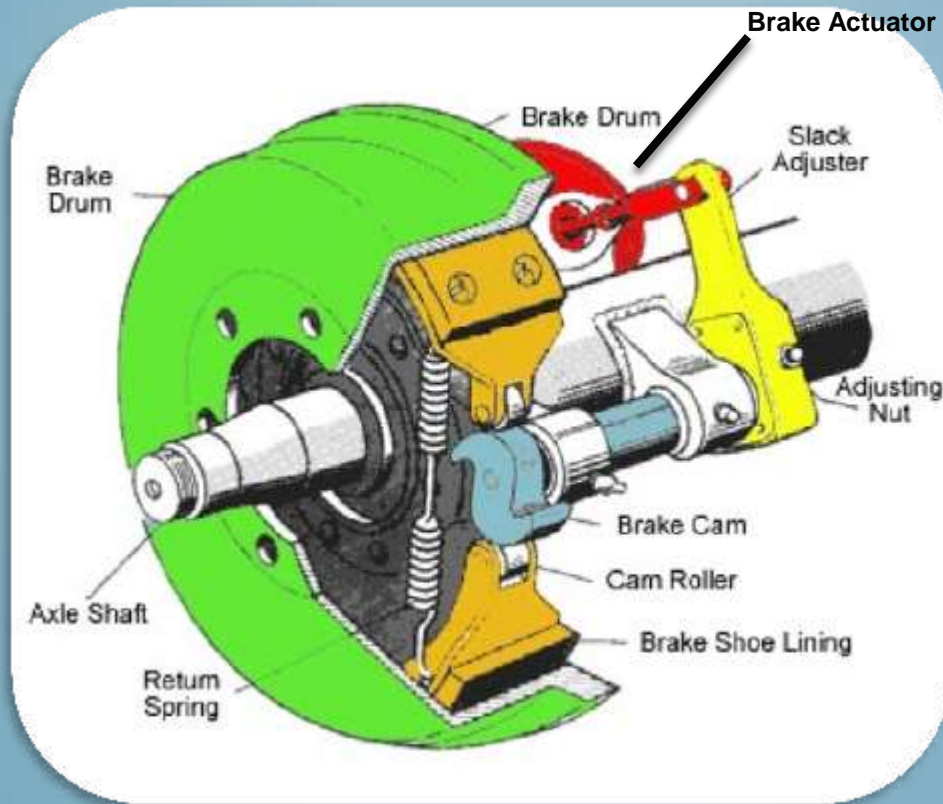


Tom Wallace - VP Electronic Braking MGM Brakes



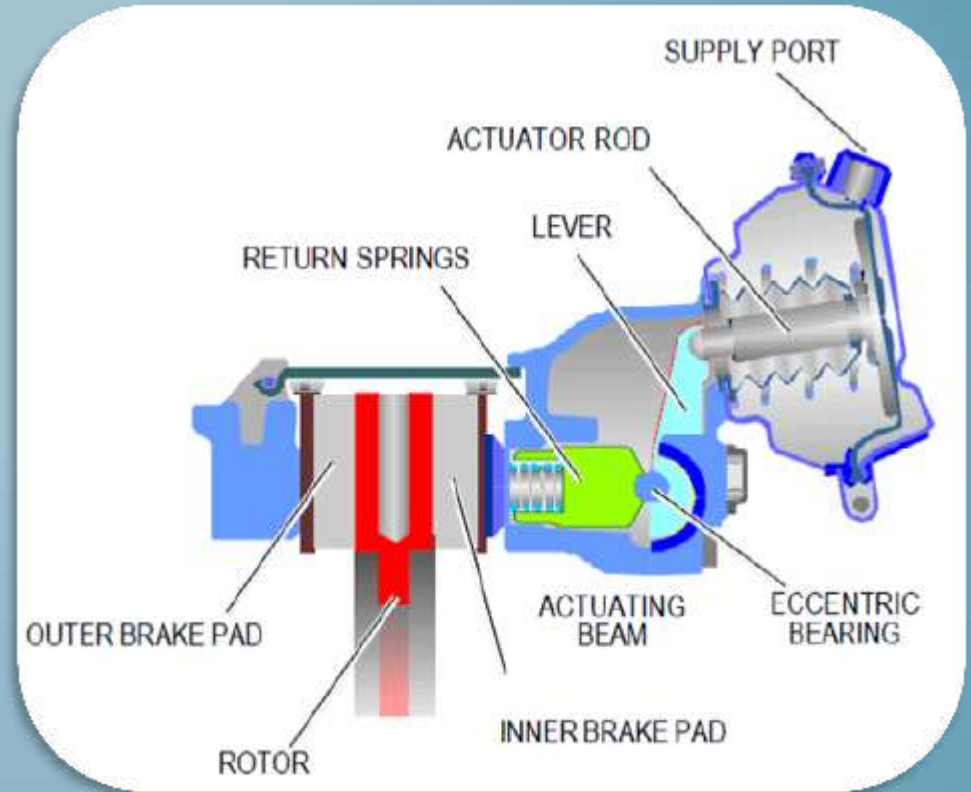
Typical Commercial Vehicle Air Brake Systems S-cam (drum) vs. Disc

S-CAM (DRUM) BRAKE



- ***Brake Components are Exposed Allowing for Basic Visual Inspection***

AIR DISC BRAKE



- ▶ *Caliper and Actuator is a Sealed Enclosed Assembly*
- ▶ *Comprehensive Visual Check is Not Possible*

MEDIUM HEAVY VEHICLE BRAKE SYSTEMS

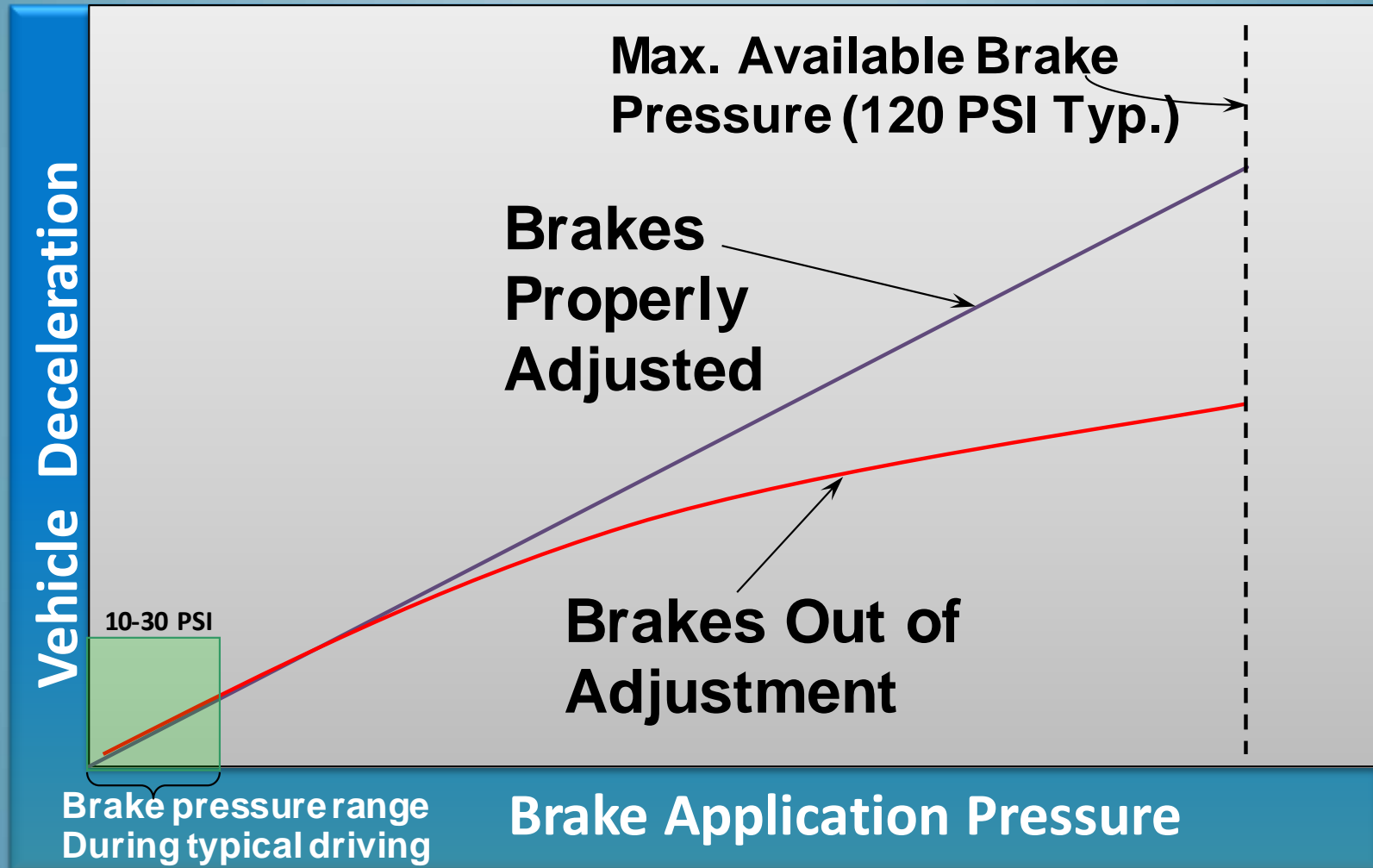
Brake setup / adjustment must be maintained and inspected daily per CDL requirements.

Brake Maintenance & Inspection – An Ongoing Problem

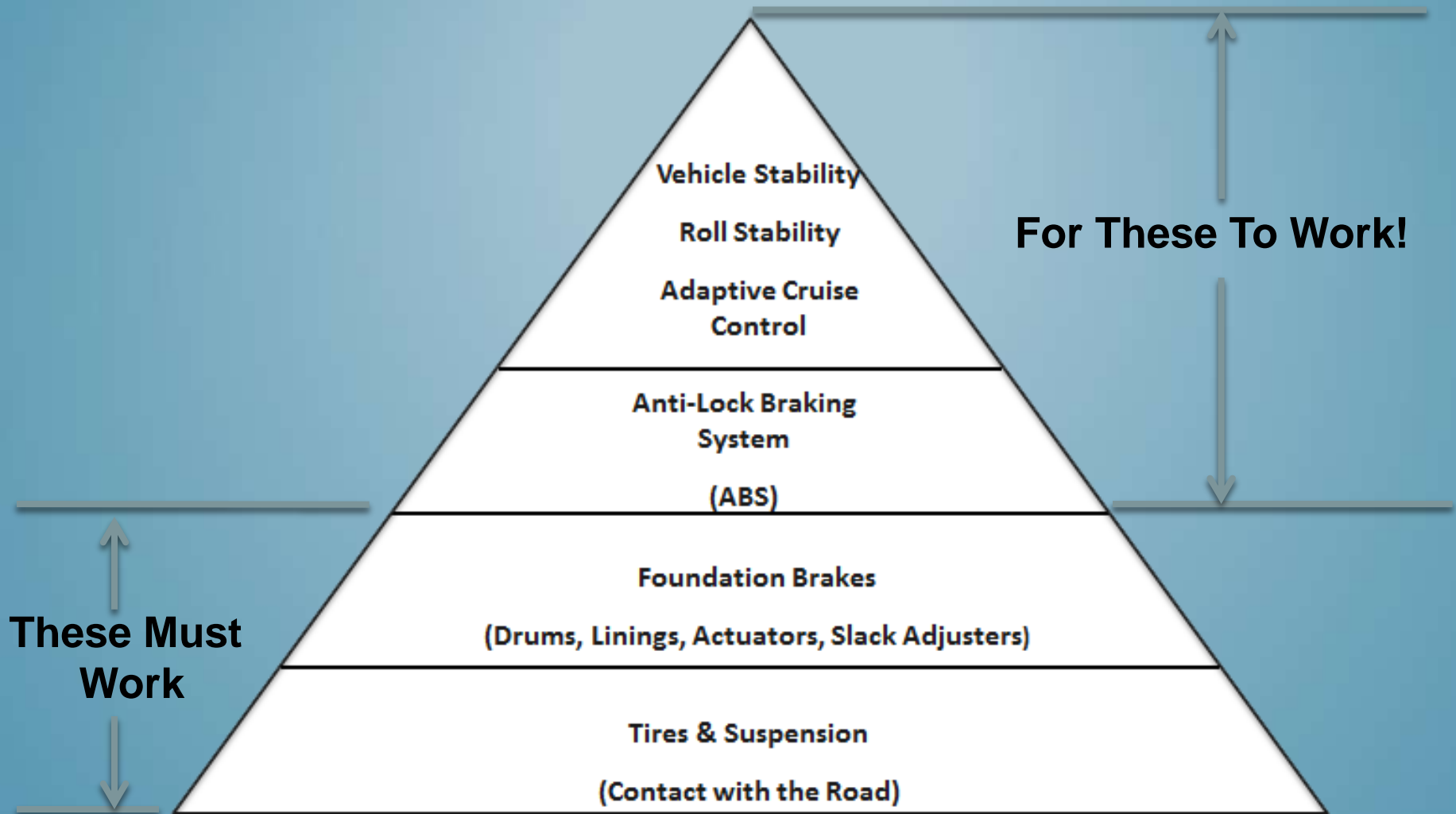
- **Daily brake inspections are often not done (time, difficulty)**
- **Shortage of qualified mechanics (constrained budgets, talent)**
- **Air Disc brakes pose unique challenges (visual inspection)**
- **Even when brakes are inspected they are at long intervals**

Why is Air Disc Brake Setup / Adjustment Important?

BRAKE ADJUSTMENT AND STOPPING DISTANCE



SAFETY TECHNOLOGY PYRAMID



WHY IS BRAKE ADJUSTMENT IMPORTANT ?

If wheel end brakes are inoperative or out of adjustment:

- **Brake force drops - stopping distance increases**
- **Potential reduced vehicle stability during panic stops**
- **Brake imbalance leads to premature component wear**
- **Dragging brakes can cause wheel fires (vehicle loss)**
- **Increased safety risk to vehicles and occupants**
- **Other safety technologies rely on foundation brakes**

Brake Inspection & Industry Trends

TRANSIT BUS COLLISIONS & COSTS U.S.A. (*PRINCETON UNIV*)

- For Calendar Year 2011:
 - 3,260 collisions
 - 12,928 injuries and 92 fatalities
 - \$483,076,010 reported casualty & liability expense
 - This equates to \$8,069 in expense per bus
- From 2003 – 2011 the bus industry (which is largely self insured) spent \$4.2 billion on casualty and liability expenses.

Current Industry Data:

CVSA Road Check 2013

- 73,023 truck and bus inspections
- 47,771 Level 1 inspections (including PBBT)
- 825 motor coaches inspections
- 24.1% of vehicles were found with OOS violations
- 49.6% of vehicle OOS violations were brake related

“Brakes routinely stand out in the mix of OOS violations issued”

Blower UMTRI Report

(University of Michigan Transportation Institute)

- Scientific analysis of data from “The Large Truck Crash Causation Study (LTCCS) conducted by FMCSA and NHTSA (2001 to 2003)
- Sample size 963 crashes involving heavy vehicles
- Actual brake inspections performed on all vehicles
- Brake data available on 826 vehicles
- 33% of vehicles had at least one brake CVSA OOS condition

“Brake violations were highest among all mechanical systems inspected”

Conclusion: Blower UMTRI Report

(University of Michigan Transportation Institute)

“Of all mechanical defects, only brake adjustment (operation) was found to have a statistically significant relationship to accident causation..”

- **No other mechanical defect found to be significant**
- **Vehicle is 1.8X (unloaded) and 3.5X (loaded) more likely to be in a crash**

Recent NTSB Investigations and Recommendations

Miriam, NV 2011: Collision between Tractor pulling two tandem trailers and Amtrak Passenger Train.

- Six fatalities, fifteen injuries
- Faulty and out-of-adjustment brakes determined to be a causal factor

Recent NTSB Investigations and Recommendations

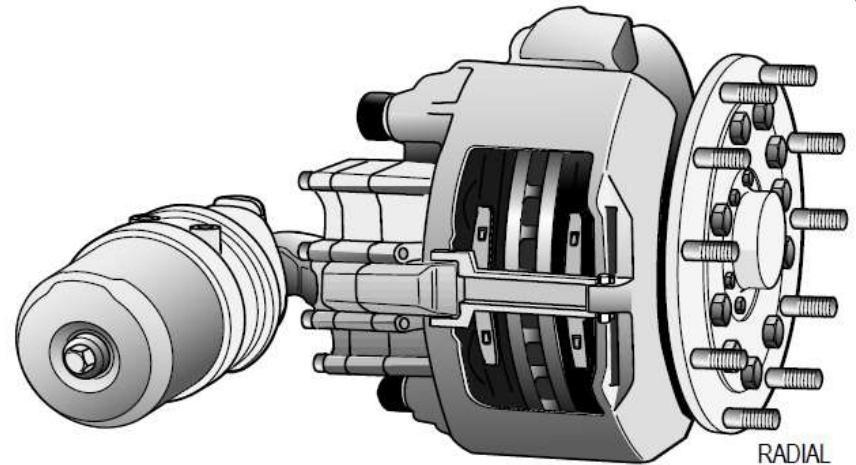
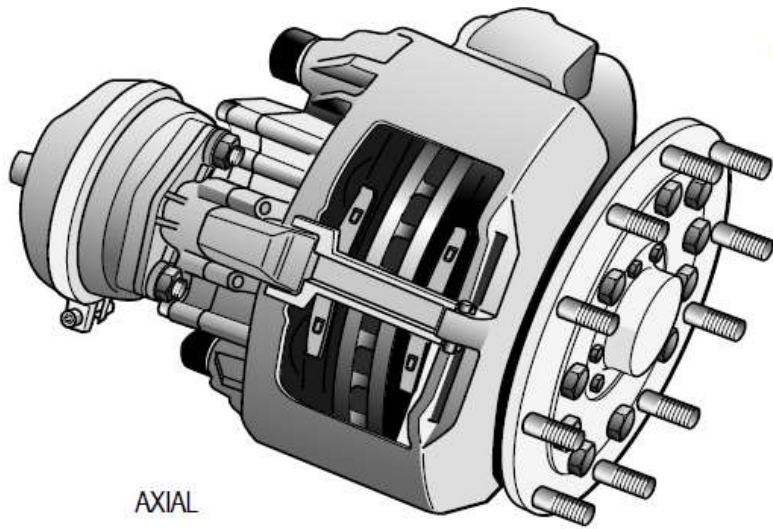
Chesterfield, NJ 2012: Collision between Dump Truck and Elementary School Bus.

- **One fatality, fifteen injuries**
- **Faulty and out-of-adjustment brakes determined to be a causal factor**

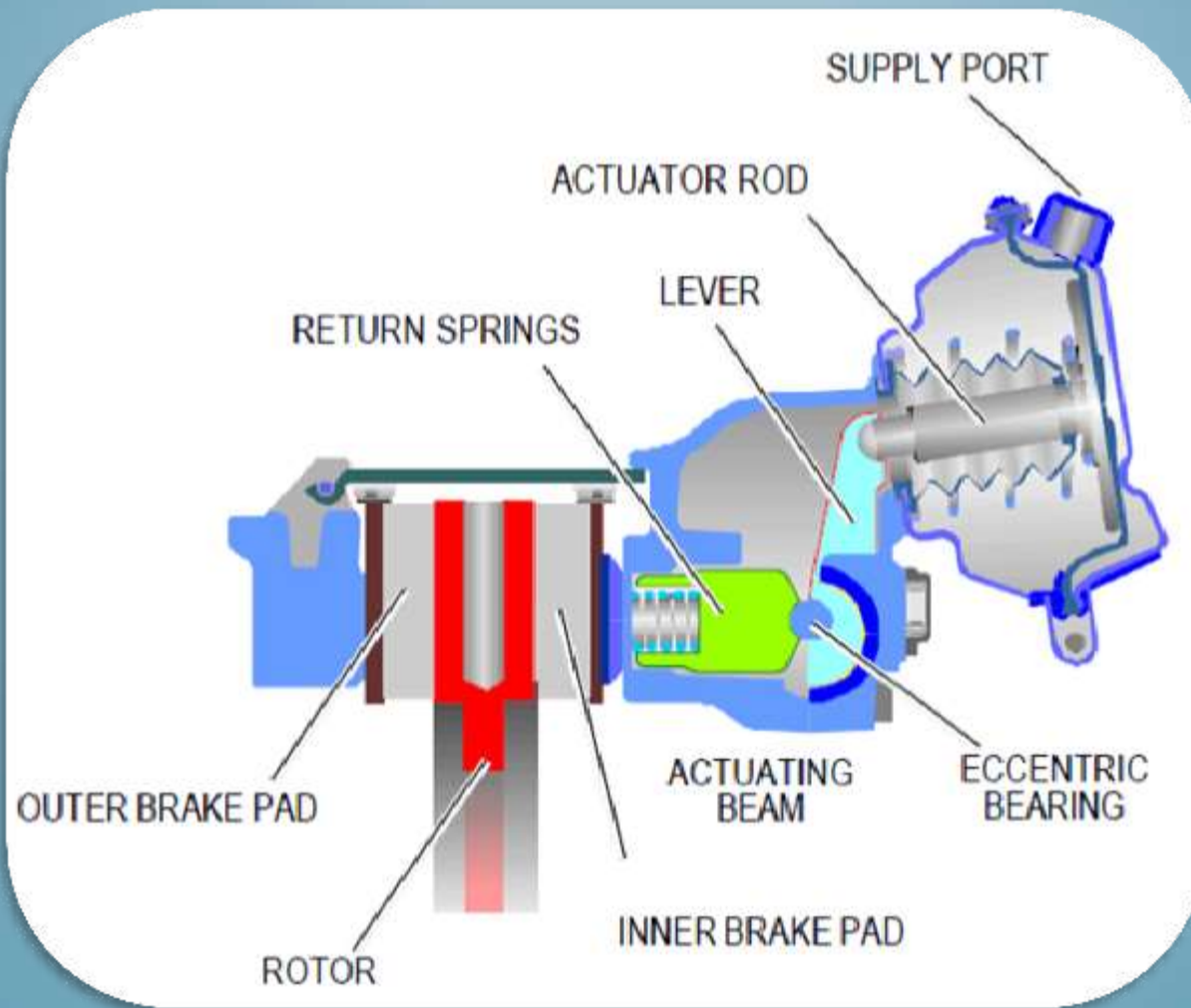
NTSB Safety Recommendations to NHTSA

- **H-12-58: Develop minimum performance standards for onboard brake stroke monitoring systems for all air braked commercial vehicles**
- **H-12-59: Once the performance standards in safety recommendation H-12-58 have been developed, require that all newly manufactured commercial vehicles be equipped with onboard brake stroke monitoring systems**

ELECTRONIC BRAKE MONITORING AIR DISC BRAKES

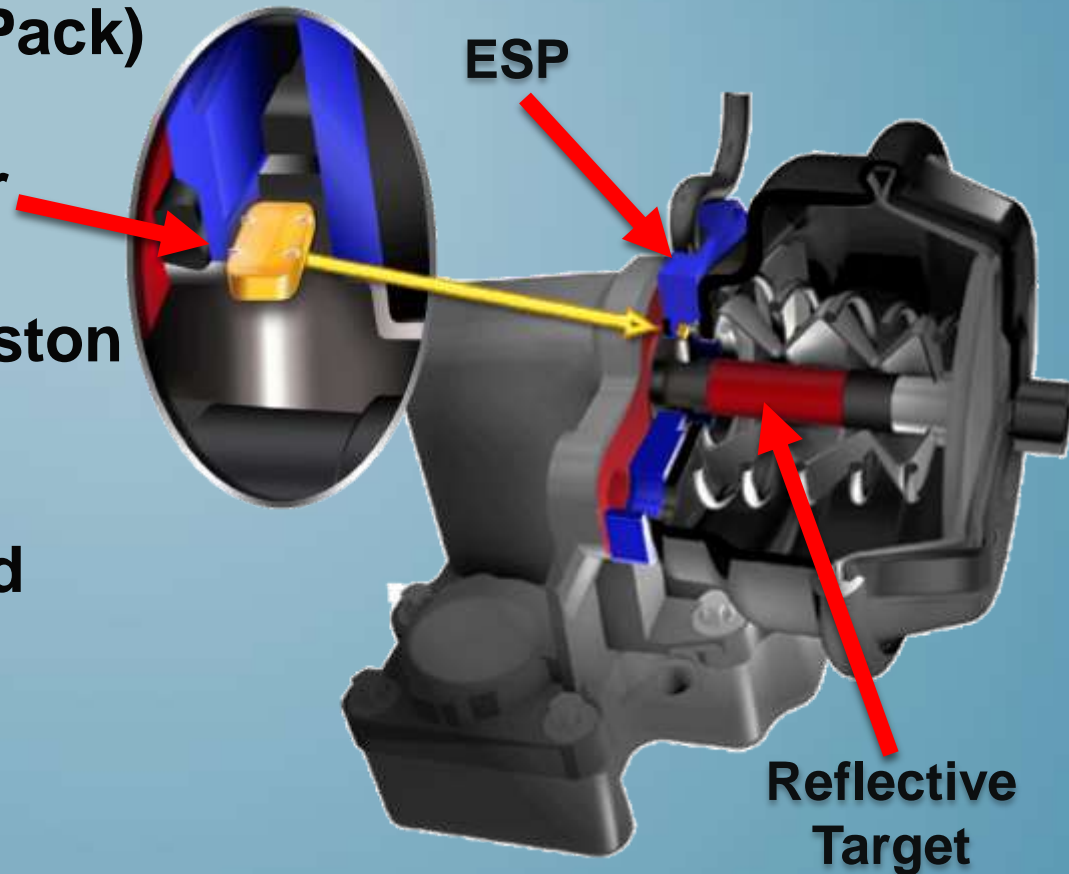


AIR DISC BRAKES – INTERNAL COMPONENTS

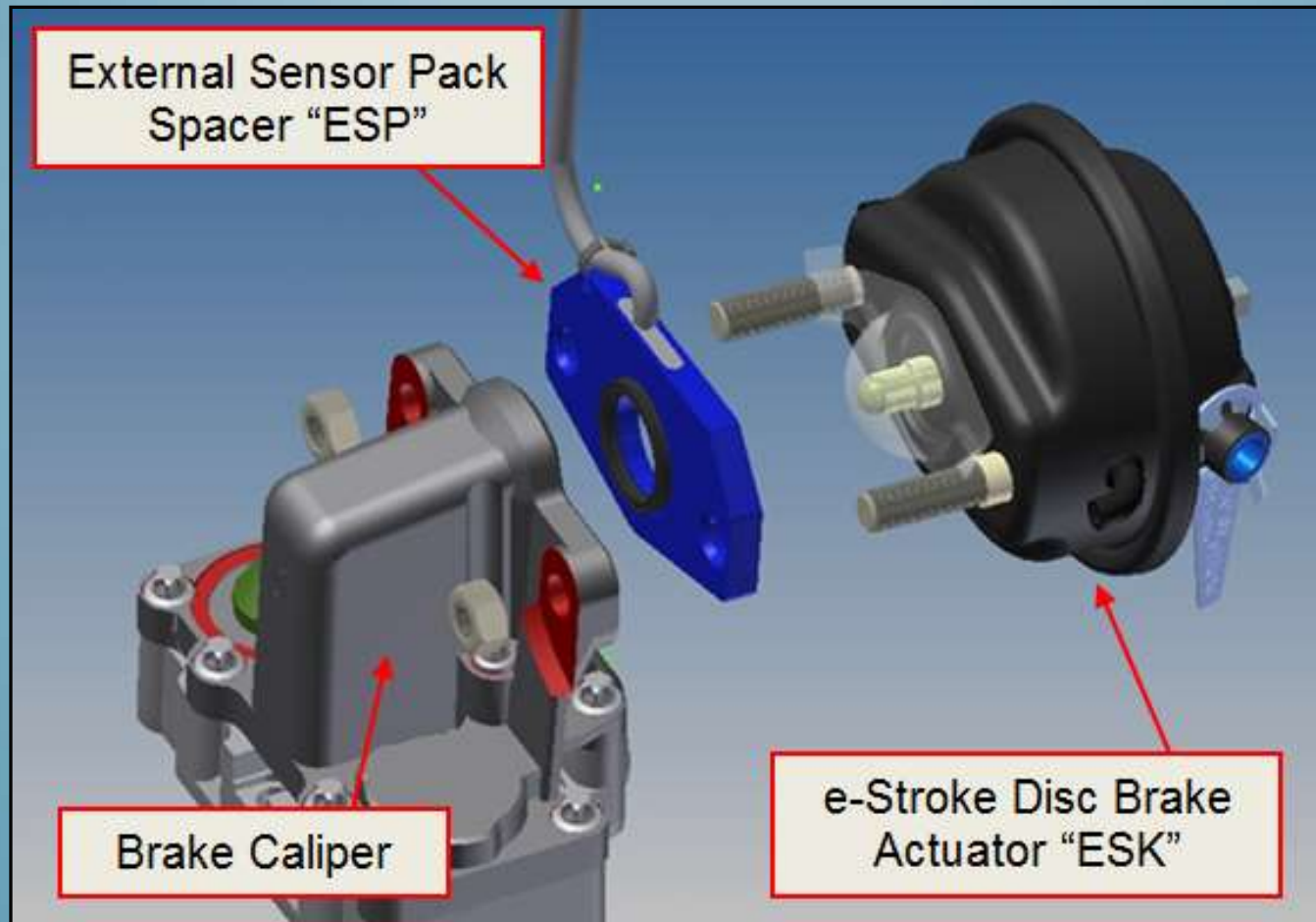


AIR DISC ACTUATOR OPTICAL SENSING

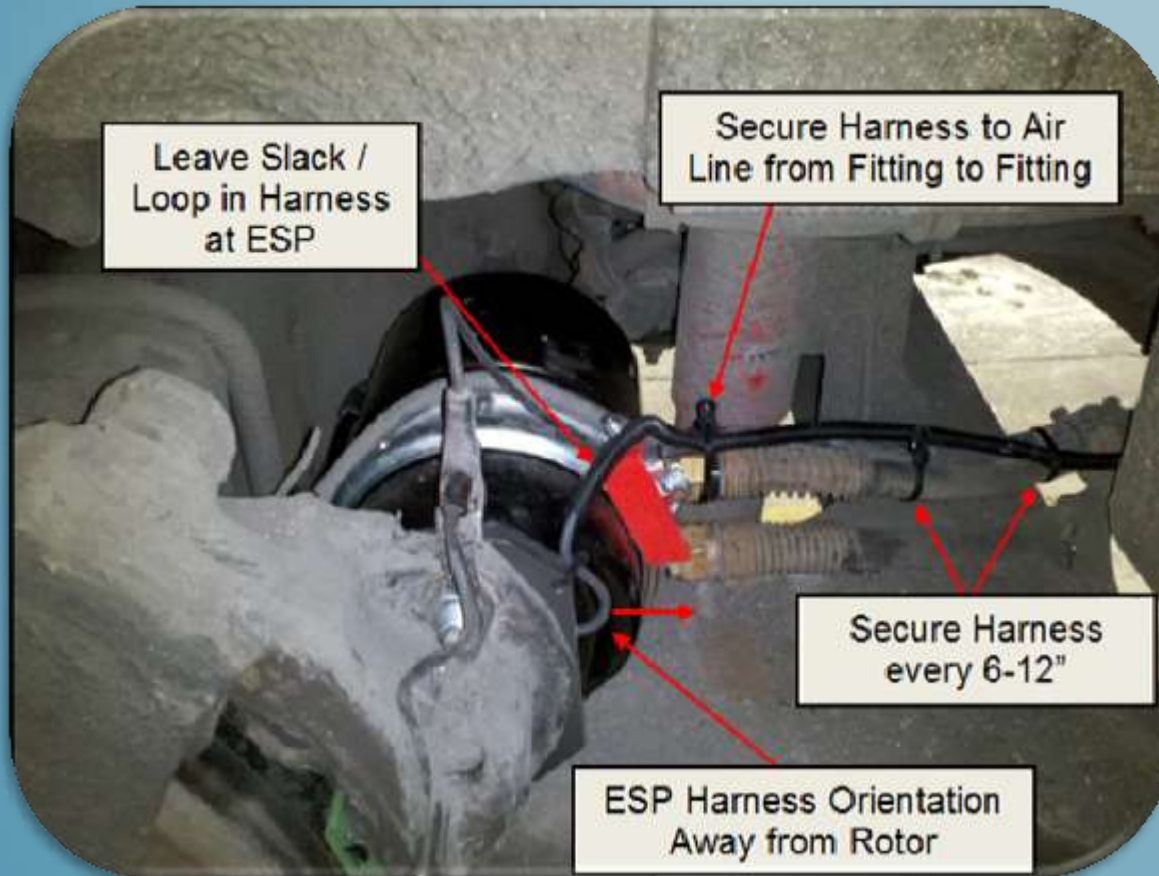
- ESP (External Sensor Pack)
- Infrared Optical Sensor
- Reflective Target on Piston Rod
- Environmentally Sealed Assembly



ELECTRONIC OPTICAL SENSOR DISC ACTUATOR ASSEMBLY



AIR DISC ACTUATOR OPTICAL SENSOR INSTALLED



- Monitors brake stroke electronically
- Can detect problems downstream: brake actuator, caliper internal adjuster, moisture, missing pads etc.
- Can detect problems upstream: Air valves, ice in the air system, improper parking brake release etc.

Electronic Brake Monitoring provides real-time wheel specific brake conditions as follows:

- Normal operation
- Over-stroke brake (loss of braking)
- Non Functioning brake (loss of braking)
- Dragging brake (potential thermal event)
- High Pad Clearance pad to rotor (loss of braking)
- Low Pad Clearance pad to rotor (potential thermal event)

Air Disc Brake Monitoring System

AVM SYSTEM



POWER 12 – 30VDC

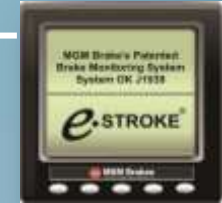


J1939 / J1708

MGM ECU



DISPLAY / DIAG



WARNING LAMP

Veh I/O



**STROKE & LINING
UP TO 8X**



**LINING UP
TO 8X**



**BRAKE PRESSURE
0 – 110 PSI**



**VEHICLE SPEED
J1939**

Fleet Advantages: Electronic Brake Monitoring

- **Safety system that protects vehicle assets & occupants**
- **Safety system that can reduce potential liability**
- **Proactive diagnostic tool that reduces maintenance costs and vehicle downtime**

ADDITIONAL ADVANTAGES TO FLEET CUSTOMER

- **Brake inspections are difficult and time consuming**
- **Air disc brakes are almost impossible to visually inspect vs. drum brakes**
- **Electronic Brake Monitoring with lining wear provides the ability to monitor the brake, caliper, and provide pad status without removing wheel.**
- **Detects air system problems, brake actuator problems and caliper problems before they become serious.**

Customer Experience

Field example caliper near thermal event caught by electronic brake monitoring system



Customer Experience

- Defective caliper internal adjusters (excess stroke)
- Driver error (no parking brake release – brake drag)
- Actuator parking brake failure (no release – brake drag)
- Caliper internal adjuster failure (via moisture intrusion)
- Quick release (QR) valve failure
- Ice in the air system
- Low pad to rotor clearance (thermal events)

ADVANCED BRAKE MONITOR CAPABILITIES

- **Automatic Engine De-rate During Brake Drag**
- **Brake Application Pressure Monitoring**
- **Real-Time Brake Status via RF / Telematics**
- **Black Box Capabilities**

MYTH: AIR DISC BRAKES CAN BE READILY INSPECTED BY VISUAL MEANS...

FALSE: Only a small portion of the disc rotor and some of the brake pads can be seen (usually only when the wheel is removed). Critical components such as the brake actuator pushrod and caliper internal adjuster are hidden and cannot be visually seen or inspected.

MYTH: BRAKE STROKE IS NOT A CONCERN WITH AIR DISC BRAKES...

FALSE: Just as with drum brakes, if the brake stroke is excessive, loss of wheel end braking can occur. It also is possible to have a non-functioning brake (loss of braking) or a dragging brake (can lead to premature wear or a wheel fire). All of these conditions can occur on disc brakes and can readily be detected by electronic monitoring of brake stroke.

MYTH: LINING WEAR INDICATORS CAN WARN OF ALL AIR DISC BRAKE PROBLEMS...

FALSE: Brake lining wear sensors only give an indication of individual brake pad thickness and do not indicate or check for proper brake air system, actuator or caliper function.

Thank You!

Questions?